THE MOST POWERFUL CELLPHONE ANTENNAS IN THE WORLD

Eliminates Noise From Digital Handsets In Hearing Aids

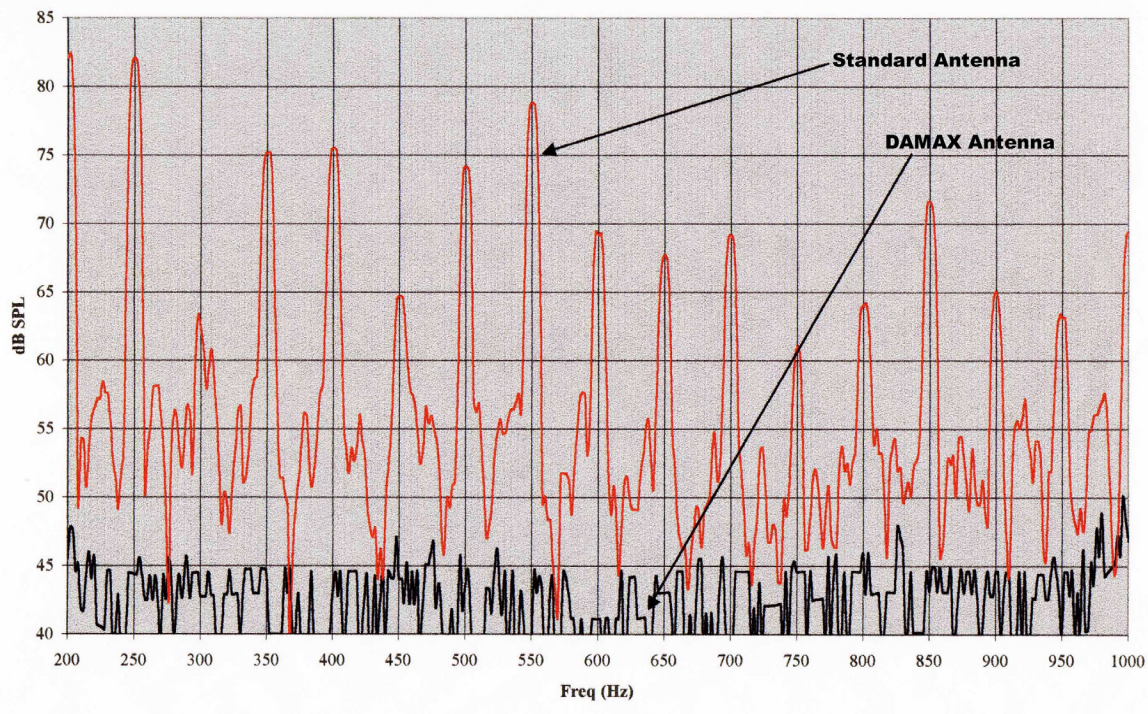
Reduces SAR From 84% To More Than 95%

(See Independent Laboratory Test Reports)

STARKEY LABORATORIES TEST REPORT

Starkey Laboratories is one of the world's leading manufacturers of custom hearing instruments with a workforce of over 4,000 people in 33 locations throughout North America, Central America, Europe, Asia, and Australia.

Comparison of Cellphone Equipped with DAMAX Directional Antenna Versus the Same Phone with its Factory Installed Antenna Operated with a Starkey Sequel ITE Aid



SAR TEST REPORTS

DAMAX has partnered with Intertek Testing Services or ITS, to assist it in worldwide introduction of its technology. ITS has a comprehensive arsenal of accreditations, recognitions and agreements, and a network of 65 laboratories worldwide. It is a Nationally Recognized Testing Laboratory for OSHA and is accredited by the FCC as a telecommunications Certification Body and by ANSI, NVLAP and A2LA, and the Standards Council of Canada. ITS also has Notified and Competent Body status in the E.U., and is a National Certification Body for the worldwide Certification Body, or CB program. ITS works with CDMA, TDMA, GSM, and AMPS, and is authorized for testing to CTIA program, and the Good Housekeeping Seal of Approval.

Following are results of specific absorption rate (SAR) tests conducted by ITS in April 2002 on the level of microwave radiation absorbed in the head from DAMAX accessory antennas installed on two popular model DCP handsets. The chart below includes calculation of the % reduction achieved by the DAMAX technology below the maximum of 1.6 watts per kilogram SAR currently permitted by the FCC in 1 gram (approximately 1 cubic centimeter) of human tissue that result from use of standard handset antennas.

	SAR (1g.)*		**SAR (10g.)***	
	Tilt	**Cheek**	**Tilt**	**Cheek**
DAMAX PCS Ant. on Kyocera 2255 (1880 MHz)	0.25 (84.4%)	0.23 (85.6%)	0.14 (91.3%)	0.14 (91.3%)
DAMAX Dual-Band Ant. on Nokia 5165 (1880 MHz)	0.09 (94.4%)	0.12 (92.5%)	0.07 (95.6%)	0.07 (95.6%)
(835 MHz)	0.12 (92.5%)	0.18 (88.8%)	0.07 (95.6%)	0.13 (91.9%)

*** Normalized to 0.25 watts.**

OTHER BENEFITS OF DAMAX TECHNOLOGY

- Plugs-in as an accessory into antenna ports designed for use with hands-free kits on the backs of numerous handsets, and can be tuned to operate with equal effectiveness in every cellphone frequency band in use worldwide:

- Eliminates the noise created in hearing aids by digital handsets by re-directing nearly 100% of standard handset omni-directional antenna signals (which create the noise) away from the head, producing a strong illumination of cellsites over an arc 160 degrees away from the head, and average reductions in microwave radiation of 10 dB over a 90 degree arc in the direction of the head:

- Provides substantial reductions in digital frame and bit error rates resulting in superior call quality, fewer dropped calls longer battery life, and handset range increases up to 160%, (see ”How Directional Antennas Work in Carrier Network Operations” page 4); and
- Permits more than 12 million people who wear hearing aids in the U.S., Canada, and the EU to use handsets in a normal operating position noise-free with either their hearing aids or cochlear implants.

HOW DIRECTIONAL HANDSET ANTENNAS WORK IN CARRIER NETWORK OPERATIONS

Independent Test Reports

First generation directional antennas developed by DAMAX CTO Greg Johnson were tested by several carriers. Although less effective than the new DAMAX technology, the early model directional handset antennas proved to outperform omni directional antennas in numerous carrier networks. Following are a few of their field test reports:

> *“After several days of testing the antenna I am very impressed. There are several areas in Phoenix that have holes regardless of the carrier because of a few mountains. Not only did my phone work in all these areas, I had 3 out of 4 bars of signal. I also went to several stores that have signal problems and all those areas worked as well.”*
>
> ***Technician for U.S. West Wireless in Phoenix, Arizona***

Western Wireless, now VoiceStream, contracted with Aethos Communication Systems to test the same model antenna in their network operations. At the time Aethos provided handset performance evaluation and managed network build-outs for Western Wireless, Aerial Communications, and other major carriers in the U.S. and abroad.

“Measurements were taken by using a Nokia 5100 phone with a factory-installed antenna compared to the same phone equipped with the directional antenna.

- ***Cellphone Receive Sensitivity:*** *At the 180º position the directional antenna produced a gain of 6 dB, which represents 400% increases in receive sensitivity from the cell site.*

- ***Transmit Power Toward Cell Sites:*** *At the 180º position facing the cell site, the directional antenna increased* cellphone *signal levels 6 dB, which represents 400% increases in transmit power to cell sites."*

In other field tests conducted by carriers with same model phones, one operated with its factory installed antenna and one equipped with the directional antenna, the directional antenna equipped phone operated at one to three commanded power steps below that of the standard antenna equipped phone. The corresponding reduction in power drawn from the battery ranged from 50 to more than 300 milliamps, which engineers calculated would increase talk-time 40% to 80%, dependant upon the phone models used.

DIRECTIONAL HANDSET ANTENNA REDUCES CDMA FRAME ERROR RATES 61.5% AND HANDSET POWER REQUIREMENTS 82.2%

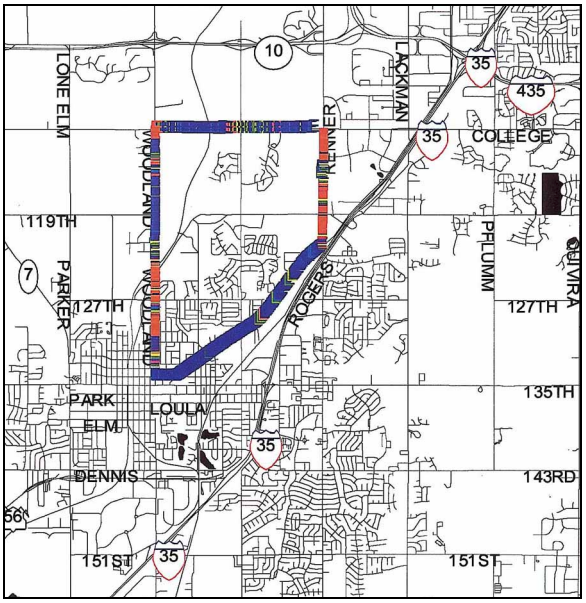
Field tests by a major carrier of the Johnson first generation directional antenna, attached to a CDMA digital cellular telephone handset, showed that the directional antenna, as compared to the standard omni-directional antenna, reduced frame error rate (FER) by an average of 61.5% and handset power requirements by -7.5 dBm, or 82.2%. The digital handset was operated at 1.85 to 1.99 GHz over a 9.7 mile loop test route that crosses varied terrain surrounded by three laboratory controlled cell sites, each with a fixed transmitting power.

The digital handset under test was positioned vertically behind the windshield of a modified Safeco van equipped with an inertial navigation system and GPS. Four comparative test loops were driven around a 9.7-mile test route; two each with the digital handset equipped with the standard factory supplied omni-directional dipole and two with the handset equipped with the directional handset antenna.

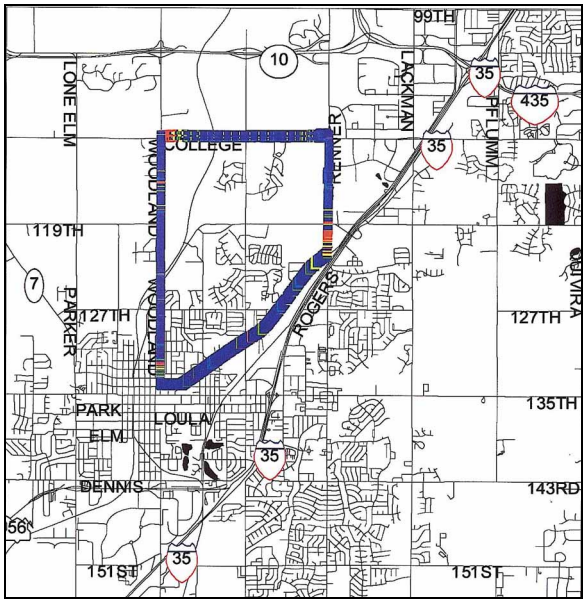
Unsatisfactory reception areas for the digital handset equipped with the dipole antenna occurred adjacent to trees and power lines paralleling the road or near power lines that intersected at right angles. One of the worst reception areas for the omni-directional dipole occurred directly in sight of the nearest transmission tower. Although strong signals were received, the multipathing, or reflection of the microwaves from surrounding objects caused the signals to arrive out of phase, which increased the FER to the point the radio was overburdened by conflicting information and dropped the call.

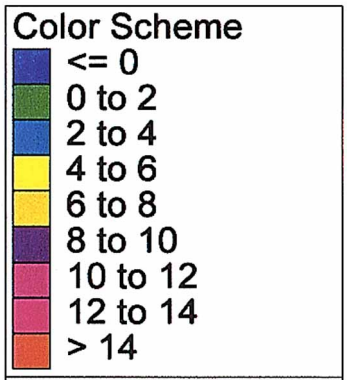
When comparative test loops were made through the same problem reception areas with the test phone equipped with the directional handset antenna, its stronger beam substantially reduced the FER which, in turn, substantially reduced dropped calls and provided better reception. According to the carrier's senior planner for RF technology who supervised the tests, the directional antenna provided an average reduction in FER of 61.5%, and an increase of 4.3 dBm in received signal power during the test runs.

FRAME ERROR RATE
Omnidirectional Antenna
(Cellsite to Mobile)



FRAME ERROR RATE
Directional Handset Antenna
(Cellsite to Mobile)





0 = Excellent Call Quality

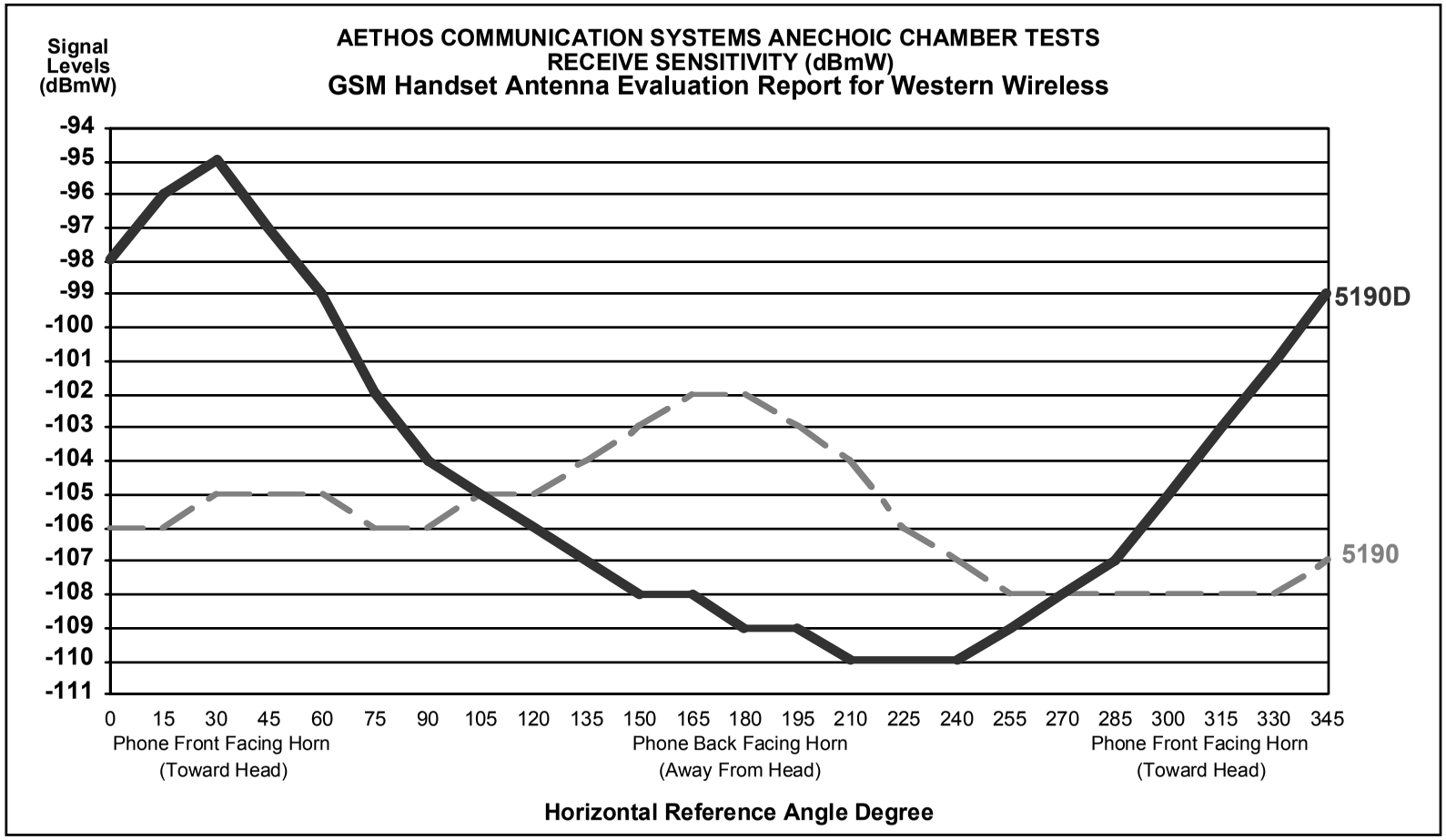
0 - 2 = Good Call Quality

2 - 4 = Less than Optimum Call Quality

4 - 6 = Poor Call Quality / Dropped Calls

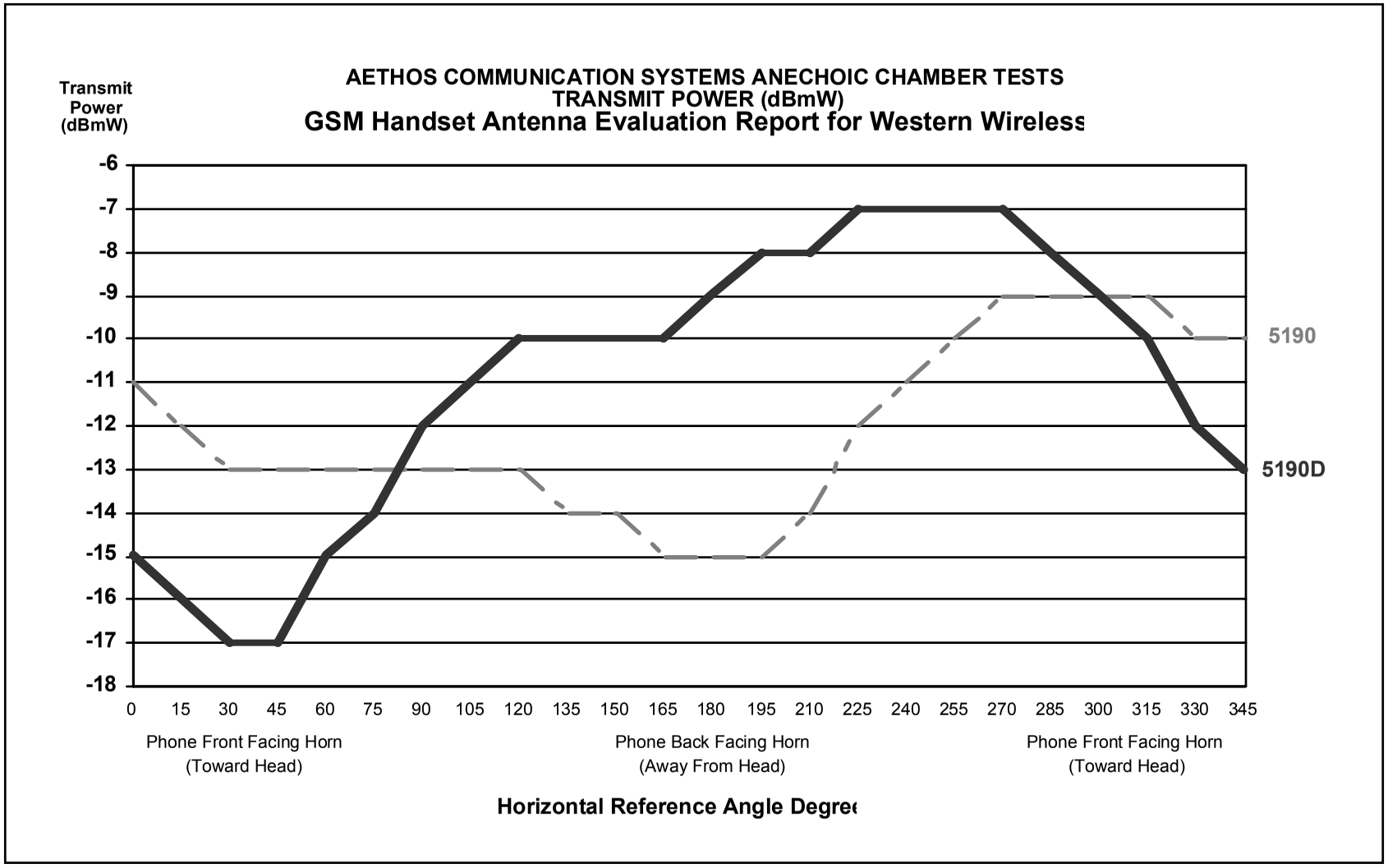
8 - >14 = Dropped Calls / No Service

Aethos Communication Systems Laboratory & Carrier Network Test Report*
Directional Antenna Increases Transmission Power Signal Levels 400%
…Reduces Signal Loss to the Head More than 60%



Note: 5190D = Nokia 5190 with clip-on Directional Antenna. 5190 = Nokia 5190 with Omnidirectional PCS Antenna

* **Aethos Communication Systems** provides system design, systems integration, handset performance evaluation, and optimization of cellular network performance to network operators such as Western Wireless, Aerial Communications and other major service providers in the U.S. and throughout the world. Aethos has offices in Dallas, Texas and Almondsbury, Bristol, United Kingdom


AETHOS COMMUNICATION SYSTEMS ANECHOIC CHAMBER TESTS
TRANSMIT POWER (dBmW)
GSM Handset Antenna Evaluation Report for Western Wireless
Transmit Power (dBmW)
-6
-7
-8
-9
-10
-11
-12
-13
-14
-15
-16
-17
-18
0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345
5190
5190D
Phone Front Facing Horn (Toward Head)
Phone Back Facing Horn (Away From Head)
Phone Front Facing Horn (Toward Head)
Horizontal Reference Angle Degree

Independent Directional Antenna Tests (Notes)

AETHOS ANECHOIC CHAMBER TESTS

Horizontal Ref. Angle Degree: Represents horizontal reference points in free space at which GSM performance measurements were taken of a Nokia 5190 phone with factory OEM antenna **(5190)** as compared to the same phone equipped with a directional antenna **(5190D)**. **"0º"** indicates the measurements taken with the phone front (earpiece, keypad and LED display which represents the side of the phone facing toward the head) facing the anechoic chamber's horn antenna and **"180º"**, the measurements taken with the phone back facing the horn.

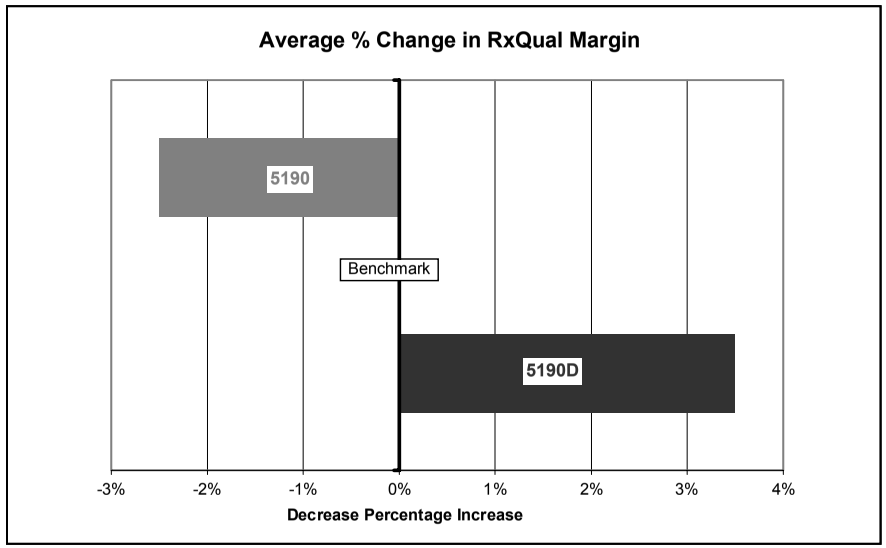
Signal Levels (dBmW): Represents transmit/receive signal measured by the anechoic chamber horn antenna in decibels miliwatts.

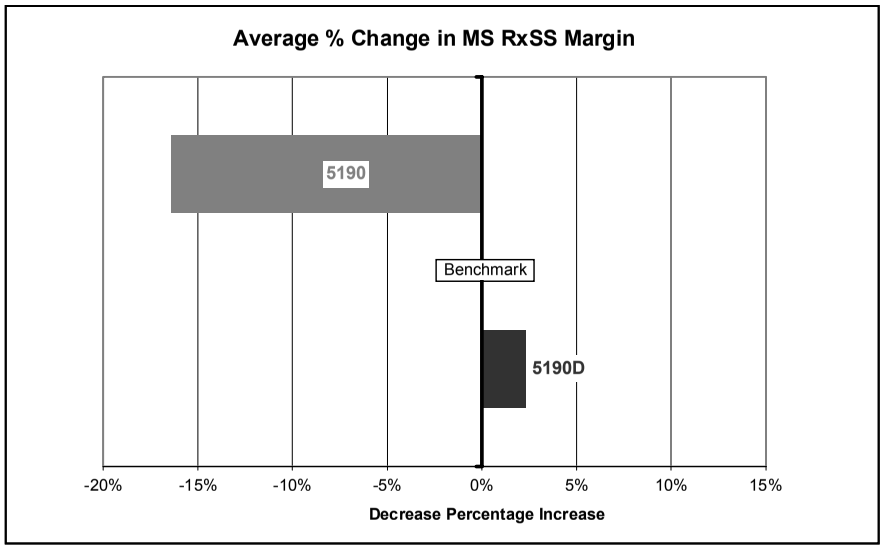
Receive Sensitivity: The receive sensitivity is determined at the signal level at which the phone is able to produce an average residual bit error rate (RBER) of 2%. At the **"180º"** position with the phone back facing the transmitting horn antenna, the OEM antenna had a receive sensitivity of -102 dBmW and directional antenna -109 dBmW. The difference of 6 dB represents a 400% increase in receive sensitivity produced at the**"180º"** position. At the **"0º"** degree position with the phone front facing the transmitting horn antenna, the OEM antenna had a receive sensitivity of -106 dBmW and the directional antenna -98 dBmW. The difference of 8 dB represents an approximate 75% reduction in receive sensitivity. However, in actual use the substantial portion of the radiation that reaches the front of the phone is absorbed by the head. Thus, this reduction in receive sensitivity at the phone front does not represent a degradation in overall receive sensitivity.

Transmit Power: At the **"0º"** position with the phone front facing the horn antenna, the OEM antenna produced a transmit signal level of -11 dBmW and the directional antenna -15 dBmW. The difference represents a decrease in signal level transmitted in the direction of the head of 4 dB, which equals a reduction of more than 60% in electromagnetic radiation absorbed by (lost in) the head*. At the **"180º"** position with the phone back facing the horn, the OEM antenna produced a signal level of -15 dBmW and the directional antenna a signal level of -9 dBmW. The -9 dBmW represents an increase in signal levels of 6 dB, which equals a 400% increase in transmit power directed away from the head.

* If .6 watts is transmitted toward the head and it is reduced by 4 dB, 4 dB equals a 61% reduction in power transmitted toward the head. Conversely, if .6 watts are transmitted away from the head and it is increased by 6 dB, which equals a factor of 4, the 6 dB increase equals an effective radiated power (ERP) of 2.4 watts, which represents a 400% increase in power transmitted away from the head.

AETHOS Directional Antenna Moving Field Tests Report





IMSI Trace Statistics for Moving Field Tests: Represents the moving field test results of relative mobile station received strength levels and relative receive quality between the selected benchmark Nokia 2190 compared to the performance of a Nokia 5190, and a Nokia 5190D (the Nokia 5190 equipped with the directional antenna)

MS RxLev <=20 dBm represents mobile station receive signal strength levels in percentage terms compared to the benchmark. The MS RxSS Margin for the 5190 in tests #1 & #2 was -8.2% and -24.7% respectively, and for the 5190 with the directional antenna, +6.2% and -1.5% respectively. This represents an average MS RxSS Margin of -16.4% for the 5190 and +2.3% for the 5190D, or an overall increase in

performance by the 5190 equipped with directional antenna of +18.7%. In addition, the **MS RxQual Margin** for the 5190 in tests #1 & #2 was +2.4% and -7.4%, and for the 5190D, +4.5% and +2.5%. This represents an average MS RxQual Margin of -2.5% for the 5190 and +3.5% for the 5190D, or an average increase in RxQual Margin by the 5190 equipped with the directional antenna of 6%.

Reported RxLev and RxQual: Consistent results in the RxLev -105 and –106 range and RxQual 3 to 4 range indicate that no penalty in phone performance throughout the horizontal ref angle degrees is created by the addition of the directional antenna.

AETHOS COMMUNICATION SYSTEMS TEST SUMMARY

RECEIVE SENSITIVITY (dBmW)

	Nokia 6190 with OEM Antenna		Nokia 6190 with Directional Antenna	
	Horizontal Ref. Angle Degree	Signal Levels (dBmW)	Horizontal Ref. Angle Degree	Signal Levels (dBmW)
0Þ= Phone Front facing horn	0	-106	0	-98
	15	-106	15	-96
	30	-105	30	-95
	45	-105	45	-97
	60	-105	60	-99
	75	-106	75	-102
	90	-106	90	-104
	105	-105	105	-105
	120	-105	120	-106
	135	-104	135	-107
	150	-103	150	-108
	165	-102	165	-108
180Þ= Phone Back facing horn	180	-102	180	-109
	195	-103	195	-109
	210	-104	210	-110
	225	-106	225	-110
	240	-107	240	-110
	255	-108	255	-109
	270	-108	270	-108
	285	-108	285	-107
	300	-108	300	-105
	315	-108	315	-103
	330	-108	330	-101
345Þ= Phone Front facing horn	345	-107	345	-99
	Average	-105.6	Average	-104.4

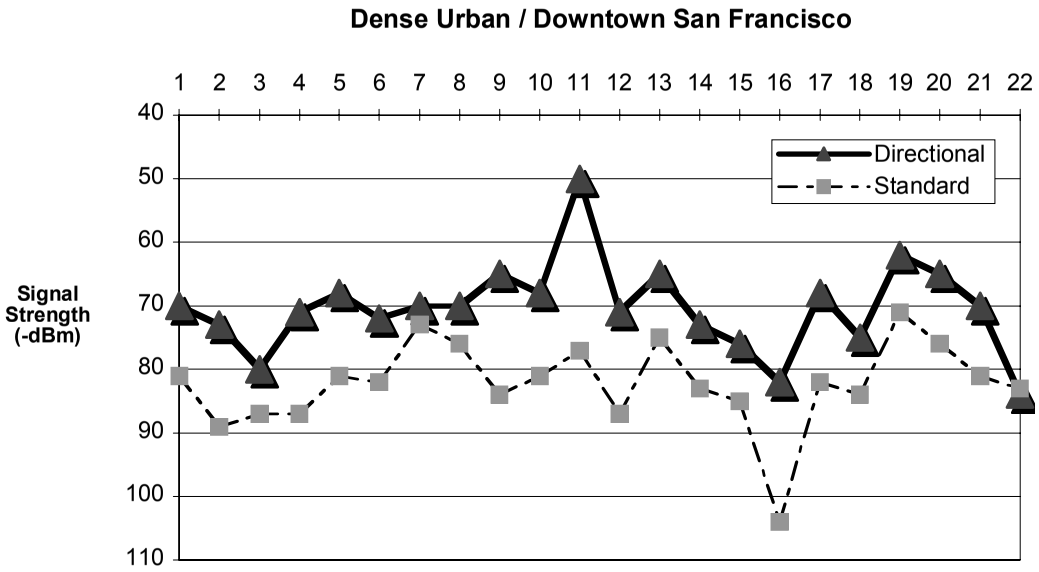
TRANSMIT POWER (dBmW)

	Nokia 6190 with OEM Antenna		Nokia 6190 with Directional Antenna	
	Horizontal Ref. Angle Degree	Transmit Power (dBmW)	Horizontal Ref. Angle Degree	Transmit Power (dBmW)
0Þ= Phone Front facing horn	0	-11	0	-15
	15	-12	15	-16
	30	-13	30	-17
	45	-13	45	-17
	60	-13	60	-15
	75	-13	75	-14
	90	-13	90	-12
	105	-13	105	-11
	120	-13	120	-10
	135	-14	135	-10
	150	-14	150	-10
	165	-15	165	-10
180Þ= Phone Back facing horn	180	-15	180	-9
	195	-15	195	-8
	210	-14	210	-8
	225	-12	225	-7
	240	-11	240	-7
	255	-10	255	-7
	270	-9	270	-7
	285	-9	285	-8
	300	-9	300	-9
	315	-9	315	-10
	330	-10	330	-12
345Þ= Phone Front facing horn	345	-10	345	-13
	Average	-12.1	Average	-10.9

IMSI Trace Statistics for Moving Field Tests

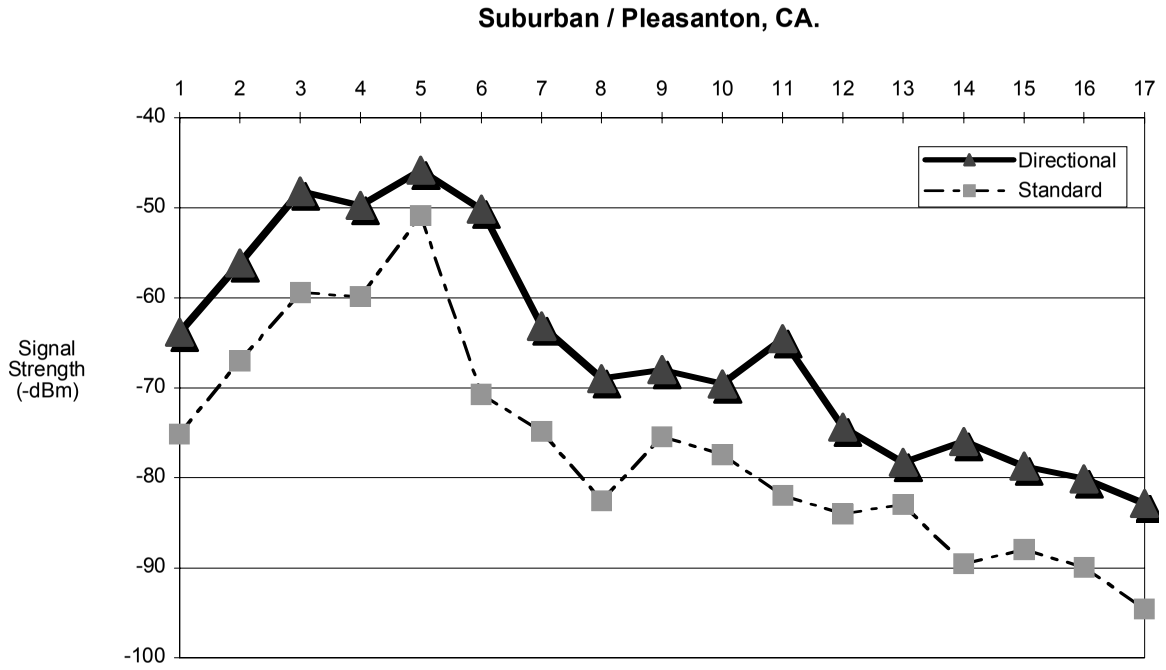
Mobile Stations	MS RxLev <=20 dBm	MS RxQual =>3	MS RxSS Margin	Average MS RxSS Margin	MS RxQual Margin	Average MS RxQual Margin
Benchmark	33.8%	22.0%				
No. 5190 #1	42.0%	19.6%	-8.2%	-16.4%	2.4%	-2.5%
No. 5190 #2	58.6%	29.4%	-24.7%		-7.4%	
Benchmark	49.6%	24.5%				
No. 5190R #1	43.4%	19.9%	6.2%	2.3%	4.5%	3.5%
No. 5190R #2	51.1%	22.0%	-1.5%		2.5%	

Performance Measure:
Received Signal Strength



Even in dense urban areas, directional antennas consistently improve performance

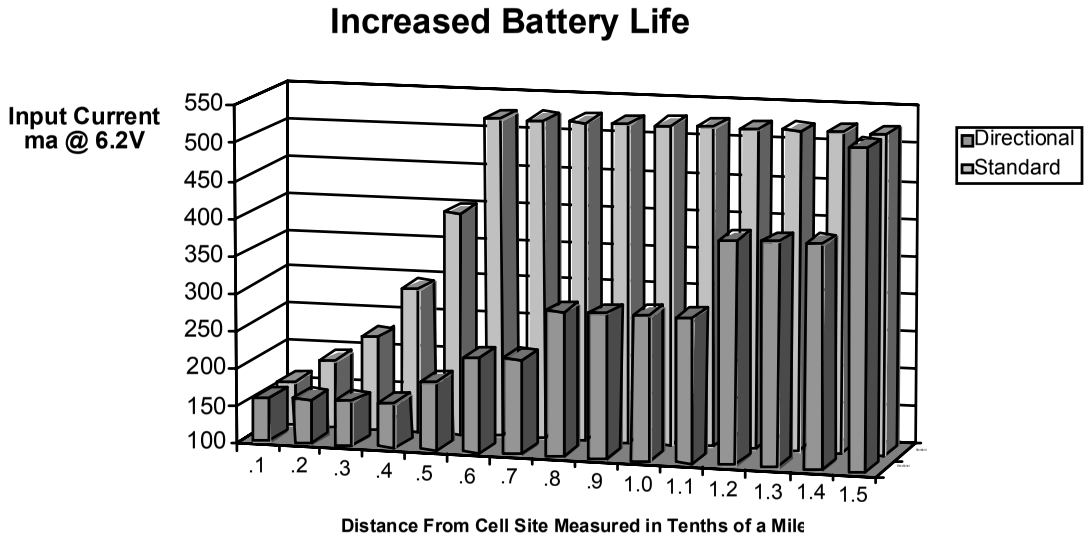
Performance Measure:
Received Signal Strength



Directional antenna significantly improved average performance by 10 dBm.

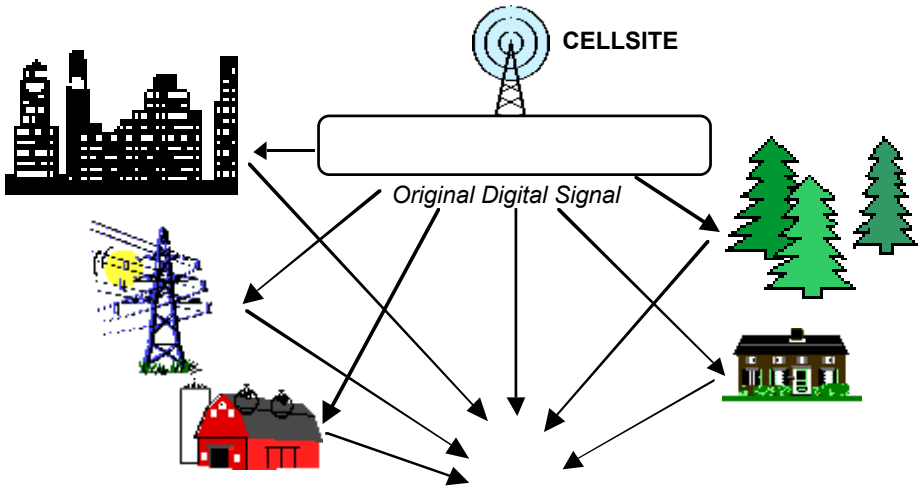
Benefits are greater range, fewer dropped calls, optimal voice quality.

Performance Measure:
Commanded Power/Battery Consumption



Directional antenna equipped phone drew considerably less power through 86% of distance test

HOW DIRECTIONAL HANDSET ANTENNAS IMPROVE CALL QUALITY



Digital microwave signals are clear and easy to lock onto at cellsites. However, by the time they reach cellphones in a typical cellular network they've multipathed, or reflected like sound waves and light off every object along the way, whether buildings, powerlines, barns, houses or trees.

The time it takes microwaves to reach cellphones is determined by the distance they travel to get there. Microwaves traveling directly from cellsites to cellphones are received milliseconds sooner than the identical signals reflected to the same phones from objects along the way. Omnidirectional antennas receive all reflected signals at about the same strength, and identical signals arriving at different times, or out of phase with one another are difficult for software to lock onto, producing poor call quality and dropped calls.

Multipath Signal Reception as seen through Omnidirectional Antenna

Directional antennas however, with a gain of 3 dB or more at the peak of their beamwidth, deliver a single more clearly defined signal that is easier for handset software to read, which produces better call quality and fewer dropped calls.

Multipath Signal Reception as seen through a Directional Handset Antenna

Typical Hearing Aid User Comments
Handset Directional Antennas

"The phone with the standard antenna was very annoying with the buzz in the background, while the same phone with the directional antenna was very quiet, and quite acceptable." *Naomi Fleer*

"The phone equipped with the directional antenna was very clear. No noise. No static. When you put the directional antenna on there, all the noise just stopped."
Paul Fredrickson

"The directional antenna equipped phone was far better and clearer and did not have any buzz or background noise to it. The same

phone with the standard antenna was unacceptable for noise and clarity, especially the noise." *Richard Fleer*

Directional Antennas on Digital Cellphone Handsets

Effect on SAR Exposures to the Head, APREL Laboratories Report

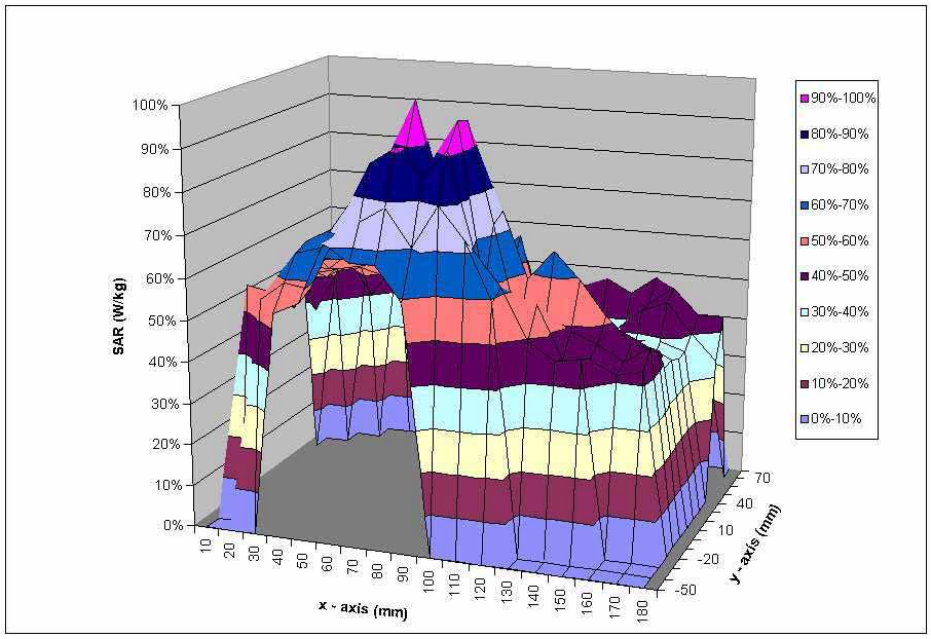
DIRECTIONAL ANTENNA REDUCES SAR UP TO 86%

In tests conducted at APREL Laboratories in Ottawa, Canada, an early model directional antenna developed by Greg Johnson, co-founder and CTO of DAMAX, was found to reduce handset SAR exposure up to 86%. The SAR measurements were made using a PCS handset supplied by a major manufacturer operated with its standard omni-directional antenna as compared to the same handset operated with a directional antenna. According to Paul Cardinal, the director of laboratory operations, indications were that the directional antenna emitted near zero SARs toward the simulated head, and that the cellphone handset was the source of the remaining SAR radiation (see SAR charts on the following page).

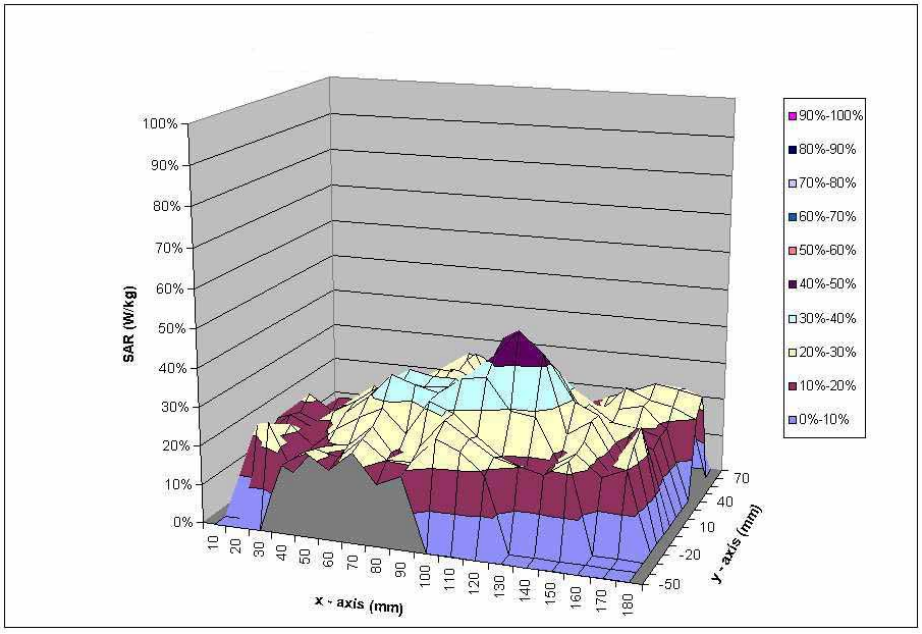
At the time the tests were conducted APREL Laboratories was listed by the FCC as one of the few laboratories in North America in compliance with their SAR test requirements. APREL had also conducted tests for the industry's trade organization, the Cellular Telecommunications Industry Association or CTIA. APREL's other clients at the time of the tests included such companies as AT&T, Nortel, Bell South, Pacific Telesis, Mitsubishi, Panasonic, and Sony.

Paul Cardinal, Ph.D., prepares SAR tests with a cellular telephone handset equipped with a directional antenna.

Local SAR with the Omni-directional Antenna Normalized to Peak (%)



Local SAR with the Directional Antenna Normalized to Peak with the Omni-directional Antenna (%)



The red spikes of high SAR in the chart at the top of the page show the penetration of the microwave signals into the simulated head cavity from the omni directional antenna.